A revision of the genus *Epiclintes* (Ciliophora: Hypotrichida) including a redescription of *Epiclintes felis* comb. n.

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Introduction

Several hundred species of ciliated protozoa have now been documented from marine interstitial sediments (Dragesco, 1974). However few of these organisms have been adequately described; indeed some forms although regularly encountered in the extensive literature on this group (Hartwig, 1980) have never been redescribed since the original accounts given by Muller (1786) and Ehrenberg (1830). In an early study, Fauré-Fremiet (1950) put forward the hypothesis that interstitial ciliates had a cosmopolitan distribution. This has subsequently been proved correct (Hartwig, 1977), and it has been recognised that these organisms may play a dominant role in the benthic ecosystem (Fenchel, 1969). The opportunity to redescribe one such truly cosmopolitan species came with the discovery of large numbers of the highly contractile hypotrich ciliate *Epiclintes felis* (Muller, 1786) comb. n. in muddy creeks near the estuary of the river Thames. A brief glance through the literature concerning this species indicated that it had been poorly described. In addition there was some confusion concerning synonymies and it was apparent that a revision of the genus *Epiclintes* was long overdue.

Materials and methods

Epiclintes felis were collected from two locations on the south shore of the Thames estuary: Oare creek, National Grid reference TR0163 and Faversham creek, National Grid reference TR0262. Both locations are near Faversham, north Kent. The organisms were found in small shallow (5–10 cm) lagoons just below the high tide line along the sides of the two creeks. They were found on the surface of the fine mud and detritus at the bottom of the lagoons or beneath the surface film of the water. The salinity of the water was 70% sea water (SW). Subsequently this species has been found at two sites on the north shore of the Thames, at Shoeburyness, Essex, National Grid reference TQ9485. At this locality the organisms were found firstly at the sand surface, 20 metres from shore, and secondly in association with the red alga *Ceramium* sp. collected 10 metres from shore. All sites were permanently covered with water at low tide.

Cells were cultured in filtered 70% SW, pH 7·8 at 18°C under constant illumination from an 8 W fluorescent lamp. Subcultures were made every 5 days. Some difficulty in handling the organisms was experienced due to their thigmotactic nature and inate fragility but when quickly transferred using a wide bore micropipette, this problem was solved. Silver stains of the cortex were prepared by the method of Tuffrau (1967). Silver stained preparations were supplemented by observations using Nomarski interference, phase contrast and brightfield

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illumination, photographs and video recordings. It was found that good structural preservation could be obtained with certain fixatives, consequently some specimens were prepared for transmission electron microscopy. Two methods of fixation were employed:

(1) Nouzarède's Method (Nouzarède, 1977) for fragile ciliates. The specimens were first fixed in 2% osmium tetroxide in 70% SW neutralised with solid calcium carbonate, for 10 minutes. They were then rinsed in 70% SW and transferred to 10 drops of sea water to a dish and two drops of 25% glutaraldehyde (also neutralised with solid calcium carbonate) were added. The organisms were fixed in this solution for 30 minutes. The ciliates were then returned to the osmium solution for a further 20 minutes.

(2) Specimens were fixed in a solution of equal parts of 3% glutaraldehyde in phosphate buffer and 1% osmium tetroxide in phosphate buffer for 20 minutes. These two fixatives were prepared in Millonig's buffer (Millonig, 1961).

In both cases the ciliates were washed in 10% ethanol and then dehydrated in graded alcohol solutions before being embedded in TAAB resin. Sections were stained in a saturated solution of uranyl acetate in 50% ethanol for 10 minutes, followed by 0·4% lead citrate in 0·1 M NaOH (CO_3^{2-} free) for 5 minutes. The first fixative preserved the pellicle most effectively and the second was employed to preserve the subpellicular structures.

Nomenclature

Epiclintes felis (Muller, 1786) was first identified by Muller (1786) under the name *Trichoda felis.* Although the description was terse and the accompanying diagram gave little information, it is still possible to recognise this very distinctive hypotrich. Muller (1786) described the form of the body as being slightly curved and transparent. It was rather rotund but posteriorly attenuated in the 'tail'. The ventral surface was seen to be covered by 'vibrating hairs' which covered the surface of the 'trunk' right up to the apex of the tail. Bory St Vincent (1824) added a little more information to Muller's description and transferred the organism to the genus *Oxitricha* as *O. felis.* He noted that the tail was frequently held curved. Once again the diagram of the species gave few details as to the placement of the cirri. The organism was also independently decribed by Claparède & Lachmann (1858) as a new species in the family Oxytrichina, *Oxytricha auricularis.* Without knowledge of Muller's *T. felis,* these authors gave a fairly detailed account of their 'new' species. They carefully described the characteristic shape of the body and the fact that the dorsal surface was seen to be ornamented by 'short batonnets' implanted in the tegument. Detailed information regarding arrangement of cirri was lacking.

In his paper of 1862, Stein proposed the name *Epiclintes auricularis* to combine Muller's (1786) *T. felis* and *O. auricularis* of Claparède & Lachmann (1858). Stein (1864) gave the first detailed description of *E. auricularis* and supplied further details in his major work (Stein, 1867). However Stein (1862) was in error in attributing the specific name '*auricularis*' to his new genus *Epiclintes.* Since the name '*felis*' was presented in 1786, 70 years before *O. auricularis* was published, the earlier name must take precedence. The correct name of the taxon is *Epiclintes felis* (Muller, 1786) comb. n. Diesing (1866) was the third author to independently identify *E. felis* and ascribe it to a new genus; *Claparedia* Diesing, 1866. Although an invalid name, his useful description noted that the peristome of the organism was situated asymmetrically and the body was extremely plastic or deformable. It was also noted that the tail region was highly contractile and caudal 'styli' were seen to be present.

Wallengren (1900) in his description of the organism he called *Epiclintes ambiguua* made a taxonomic error which has subsequently led to great confusion. He stated that the species *E. ambiguua* was first named by Stein (1862) after Muller's (1786) original description of *Trichoda ambiguua.* This is incorrect, Stein (1862) described *E. auricularis,* based on the description of *T. felis* Muller (1786). However Muller (1786) did describe a *T. ambiguua* but it is doubtful if this organism is a hypotrich and most certainly does not belong in the genus

Epiclintes. Kahl (1932) failed to note the error and adopted the name *E. ambiguus*; so that subsequently the name *E. ambiguus* appears regularly in the literature. Apart from this lapse in the nomenclature of the organism, Wallengren (1900) went on to give an excellent description of his species, which was undoubtedly *E. felis*. Since these first accounts, many workers on interstitial ciliates have included information regarding this hypotrich, but none has clarified the important details of cirral arrangement, division and behaviour.

Morphological Description

Epiclintes felis (Muller, 1786) comb. n.

E. felis may be described as a genuinely psammophilic species, that is to say, it can be found on, or at least temporarily associated with, sand of the intertidal zone rather than between the interstices. From Figs 1 & 4 it can be seen that the body of this hypotrich is divided into three distinct regions; a dorsoventrally flattened 'head' region leading via a thin neck to a rotund 'trunk' which terminates in an attenuated 'tail'. Many authors have commented on the fact that the organism is highly contractile, with the ability to shorten to at least 25% of its initial length. It is quite clear that the diversity of form recorded for this species is the result of the organism having undergone contraction to a varying degree. All observations recorded here are based on extended cells unless otherwise stated. However in either contracted or relaxed state, the three regions of the body are a permanent feature. The true appearance of the body is best seen when the organisms have been left undisturbed for some time. In normal locomotion over the substrate, the body is held extended and frequently slightly curved. The head and tail regions are transparent but the central trunk region is translucent and is frequently seen to be full of food materials. In culture *E. felis* was seen to feed on bacteria but frequently, in freshly collected material, diatom frustules were seen within the body. The hypotrich is colourless but Bütschli (1887–1889) noted a yellowish tint. Claparède & Lachmann (1858) were the first authors to quote an accurate size for *Oxytricha auricularis*. They recorded a length of 300 μm. Other reports quote a range of sizes varying from 200–300 μm, Stein (1864, 1867), Mereschkowsky (1879), Rees (1884), Kahl (1932). In this study the species was found to vary in size between 100–350 μm.

'Head' Region

This region illustrated in Figs 2 & 5 is anteriorly rounded and dorsoventrally flattened. It is truly auriform or 'ear-like' hence the etymology of Claparède & Lachmann (1858). In extended, normally moving animals, the head is equal to or one and a half times as broad as the trunk region. Many earlier authors regarded the trunk as possessing greatest breadth but it is clear that their observations were based on at least partially contracted animals. From Fig. 5 the asymmetric adoral zone of membranelles (AZM) extends around the anterior head region on the ventral surface and along the left side of the oral area entering a distinctive tubular buccal cavity. The cytopharynx is clearly visible but the cytostome is not. The AZM itself comprises some 25–35 fine membranelles held erect. These are twice the length of the cirri on the body, and extend as far as the buccal oveture. Here the membranelles form a distinctive 'cage'.

'Trunk' Region

This region is ovoid tapering anteriorly to the head region and posteriorly to the elongated tail. Its length varies with the degree of contraction; in the extended state it is at least twice the length of the anterior portion. When contracted it may equal the head region in length. In normal locomotion the surface of the cell adjacent to the substrate is somewhat flattened. This would account for the thigmotactic nature of this region. On contraction the dorsal surface of the organism becomes distinctly convex in shape, the ventral surface retaining its flattened appearance. This central region may become distended by food material. The

contractile vacuole is single and as Kent (1880–1882) has correctly stated, it may be situated centrally or may be found on the left near the termination of the peristome field. The cytoproct is clearly visible at the dorsal surface, just at the junction of the trunk region and tail. The number and form of the macronuclei has been poorly described; early authors described this organelle as a single hoop-shaped body. The macronuclei are in fact small

Figs. 1–3 *Epiclintes felis* photographed by Nomarski interference microscopy: (1) Entire organism, dorso-lateral view, bar represents 10 μm; (2) 'Head' region, ventral view, bar represents 7 μm; (3) 'Tail' region, ventral view, partly contracted, bar represents 8 μm.

and numerous and are, as Wallengren (1900) noted, spherical or ovoid. Due to difficulties in staining this hypotrich, the micronuclei have never been observed.

'Tail' Region

The tail is relatively long, see Figs 1 & 4, at least the length of head and trunk combined, and tapers quickly from the hind regions of the trunk, then less so to its end which is gently rounded. As seen from Figs 1 & 3 this caudal region is very characteristic due to the arrangement of cirri which give it a plaited or braided appearance, especially when contracted. Kahl (1932), for example, noted that it resembled a fishbone. It is usually dorsoventrally flattened and distinctly ribbon-like. This region is highly contractile, much more so than the head or trunk. Possibly longitudinal contractile fibres, akin to the myonemes of peritrich ciliates, are present in the tail as shortening is so rapid. These could contribute to the braided appearance seen so clearly on contraction. The tail serves to periodically jerk the body backwards during normal locomotion. Also on shortening it is frequently noticed that the tail may bend or flex at the junction with the trunk region. It has the ability to bend at least 90° from the longitudinal axis of the cell without sustaining damage. Many of the early workers noted correctly that this region contained no food materials.

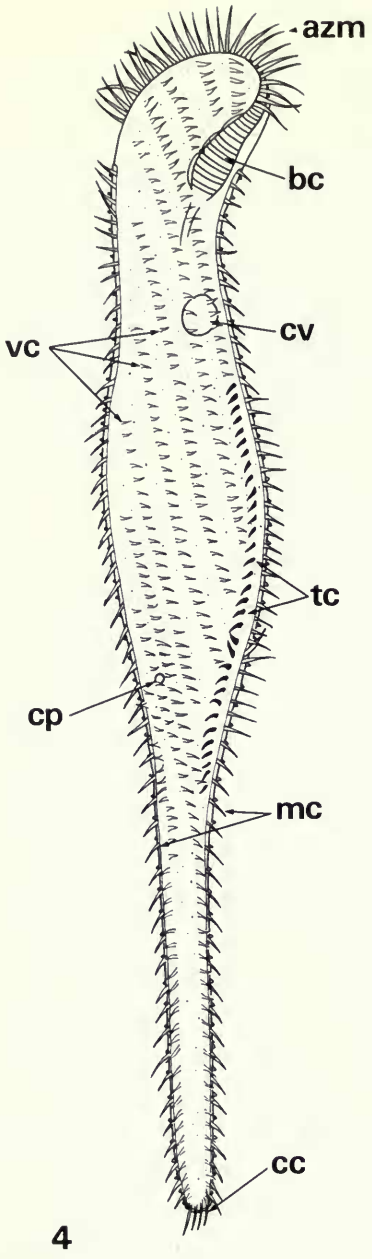
Cirri

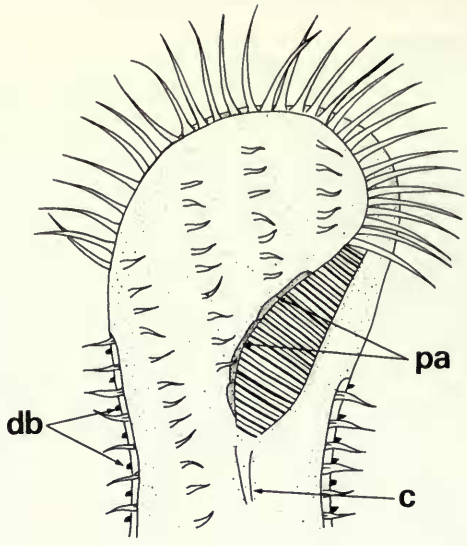
Dorsal Cirri

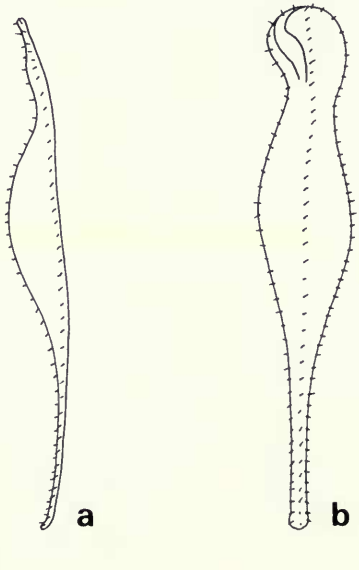
It can be seen from Fig. 6 that the dorsal surface of the organism is ornamented by sensory bristles, which take the form of very short non-motile cilia each apparently arising from a shallow pit. There are three distinct longitudinal rows of single, equally spaced bristles in *E. felis*. The first row arises at the edge of the peristome at the extreme anterior edge of the cell, passes over the head in the midline thence to the trunk and terminates at the posterior extremity of the tail. This row is most easily observed from the lateral view. The two other rows lie on the dorsal surface, at the lateral edges of the organism. They pass round the anterior margin, down the sides of the body and meet the first row at the extremity of the tail. Claparède & Lachmann (1858) were the first authors to identify these organelles in this species. These were the 'batonnets of the tegument'.

Ventral Cirri

Unlike the dorsal surface, the ventral surface of *E. felis* is equipped with many rows of short cirri. These take the form of thick bristles that taper distally. They are used extensively in swimming. Bütschli (1887–1889) noted correctly that these cirri constantly oscillate. Due to the constant movement of the organism and the translucency of the trunk region, it was very difficult to observe the numbers and arrangement of cirri without silver impregnation methods, and this could account for the great discrepancies reported by earlier workers. The ventral surface of the head region is equipped with three diagonal rows of cirri, Fig. 5, running right to left from the extreme right margin of the cell to just over two thirds the width of the body. The first lies parallel to the long axis of the cell, the second and third becoming rather more diagonal. The third row terminates at the end of the buccal cavity. Again, almost impossible to observe without staining is the paroral apparatus which runs from the base of the buccal cavity and part way up its right side. The membranes are small and may be subdivided into two or three parts. The fourth ventral row, which may be termed the first row of the trunk region, starts in the head, passes close to the end of the buccal cavity but continues over the trunk region becoming less diagonally slanted as it does so. The cirri in these rows are fairly short and stumpy and are all separated to the same degree, thus cannot be sub-divided into frontoventrals or midventrals. Stein (1864, 1867) and Bütschli (1887–1889) both stated that three rows were present in this area. Again the number of rows of cirri on the trunk region has been poorly reported. Earlier authors did not state clearly whether or not these ventral rows extended into the tail. Muller's (1786) description gave four or five rows for this central portion while Stein (1864, 1867) claimed six or seven.







Figs. 4–6 *Epiclintes felis:* (4) Entire organism, ventral view, (azm) adoral zone of membranelles, (bc) buccal cavity, (cv) contractile vacuole, (tc) transverse cirri, (mc) marginal cirri, (cc) caudal cirri, (vc) ventral cirri, (cp) cytoproct; (5) 'Head' region, ventral view, (db) dorsal bristles, (pa) paroral apparatus, (c) cytopharynx; (6) Lateral **a,** and dorsal **b,** views illustrating arrangement of dorsal sensory bristles.

Claparède & Lachmann (1858) noted five short strong rows in the tail region but these probably included rows of marginal cirri which are known to be present, no definite number of trunk rows is mentioned in their description. Rees (1884) claimed a total of twelve rows over the entire body, his diagram shows eight on the trunk and one on the tail. Mereschkowsky (1879) gave a total of twenty for the entire cell, nine for the central portion and five upon the tail. The excellent diagram of Perejaslawzewa (1886) shows a total of seven, three on the anterior and four on the trunk, two of which continue into the tail. Wallengren's (1900) description of *E. ambiguua* depicted six oblique ventral rows on the trunk and six rows beginning in the mid-trunk region and entering the tail. Nevertheless it can be seen that there are eight rows running diagonally across the body from right to left (Figs, 4 & 7), the last two enter the tail region and are continued to the tip, passing near the mid-line. These cirri are of similar length and are equally separated, but all of the eight rows can only be visualised in stained preparations. Frequently it is seen that these rows of cirri become interlaced and form a distinctive crest down the mid-line of the tail.

Marginal cirri are a characteristic feature of this hypotrich species, see Figs 1 & 4. There is a continuous peripheral row of short marginals beginning just behind the termination of the peristome field on both right and left sides, which pass down the lateral edges of the body and join at the apex of the tail. The cirri on the right side appear slightly longer than the left. Stein (1864) noted bristle-like marginals whilst Calkins (1902) showed that they projected from the lateral edges and that they were elongated at the posterior of the cell. The two marginal rows lying at the periphery of the tail and the two ventral rows lying adjacent to the mid-line have, in earlier reports, often been seen as four separate rows in this caudal prolongation. A band of transverse cirri, clearly distinguishable from the ventral cirri by their separate rhythm of oscillation, run down the left side from the first trunk row to the first beginnings of the tail (Fig. 7). They approximate in size and shape to other cirri of the ventral surface. A very short band of caudal cirri, numbering four or five emerge from the ventral surface of the tail. These are finer and slightly longer than the ventrals and marginals and are the caudal 'styli' seen by earlier workers.

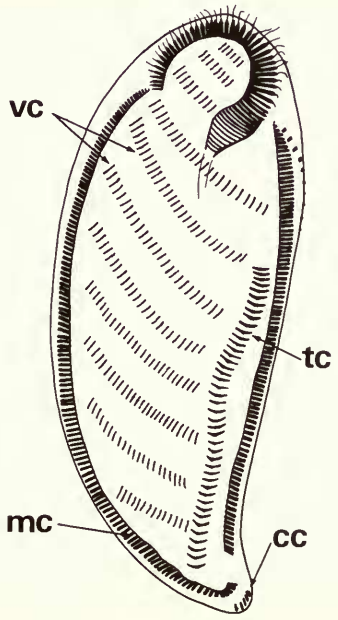


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Fig. 7 *Epiclintes felis*, ventral view of silver stained preparation, (tc) transverse cirri, (mc) marginal cirri, (cc) caudal cirri, (vc) ventral cirri.

Division

Division in *E. felis* was observed on a few occasions during this study but precise details are lacking, therefore a description of stomatogenesis and associated development is not given. Wicklow (1979; pers. comm.) clarified the events accompanying stomatogenesis in this unusual hypotrich. In a detailed study of its morphogenesis he found that *E. felis* possessed a ventral primordium from which many of its ventral rows develop. The row of transverse cirri develop from the posteriormost ends of proter and opisthe cirral streaks. Fission is isotomic, the opisthe retaining the elongate tail and the proter swimming away from division with a simple cylindrical body. The new AZM was seen to develop from the anteriormost of the transverse cirri, in the mid-trunk region.

Ultrastructure

When sectioned, *E. felis* is seen to be unique with the dorsal surface of the cell covered by a multilamellate pellicle of about sixteen layers thick (Fig. 8). This thick pellicle extends down either side of the organism but is modified on the ventral surface. In the vicinity of the ventral cirri the pellicle reverts to the more normal ciliate structure (Pitelka, 1969), but in other regions the multilamellate appearance is seen but the number of layers is reduced to five or six. This unusual pellicle does not extend up onto the dorsal sensory bristles but terminates in a funnel-shaped structure (Fig. 9) rather than a simple pit as seen for example in *Euplotes* (Ruffolo, 1976), which surrounds the base of the organelle. The repeat distance in this thick pellicle is about 6 nm, thus giving a total width for the pellicle of about 100 nm. The lamellae have the appearance of a series of unit membranes in a collapsed condition. The existence of this multilayered pellicle and its function in this highly contractile hypotrich is certainly worthy of further investigation.

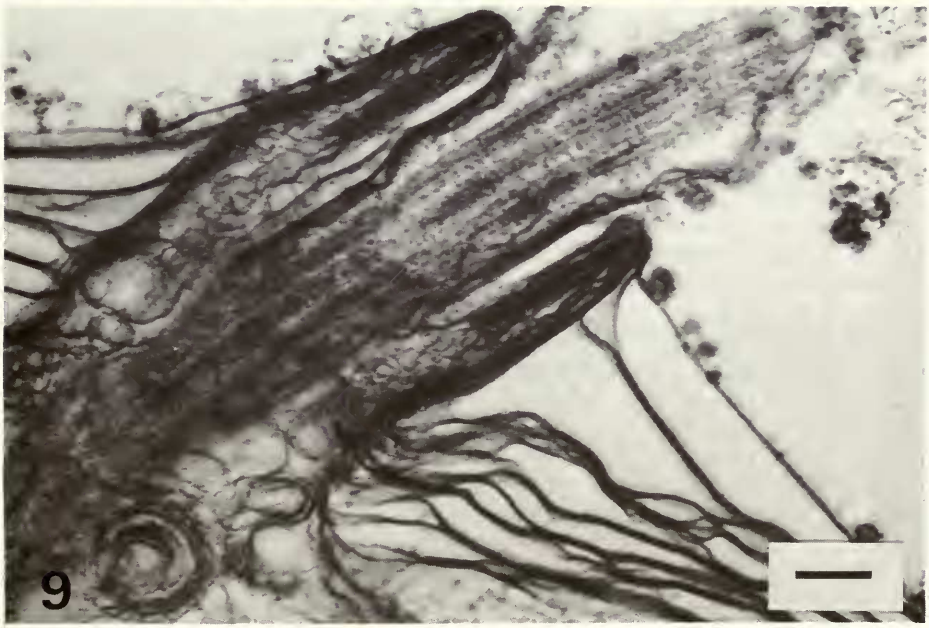
Diagnosis of the Genus *EPICLINTES* Stein, 1862

Trichoda Muller, 1786 (In part)
Oxytricha Claparède & Lachmann, 1858 (In part)
Claparedia Diesing, 1866

A free swimming genus of hypotrich, with a flexible and elastic body. The organism exhibits characteristic cycles of contraction and relaxation. The body is divided into three regions; anteriorly the head is dorsoventrally flattened, bounded at the apex of the cell by the peristome. It tapers gradually to the central portion which is cylindrical. The trunk is twice the length of the head and is usually filled with food materials and granular inclusions. The posterior portion takes the form of an attenuate tail, the length of which may roughly equal or extend to at least three times the length of both head and trunk combined. The trunk and tail are flattened ventrally contributing to the organisms thigmotactic abilities. The peristome is asymmetric, commencing right and enlarging as it traverses the anterior of the cell. The AZM terminates on the left, within the head region, in a distinct buccal cavity. Paroral membranes are present on the right side of this buccal cavity. The ventral surface of this organism is equipped with several rows of short stumpy cirri passing longitudinally or diagonally across the body. These cannot be separated into frontoventrals or midventrals. Marginal cirri are placed in one or two rows along the sides of the trunk and tail. A row of transverse cirri is present, running from just behind the peristome to where the trunk narrows at the start of the tail. A short band of caudal cirri is present also at the tip of this tail. Marine.

Species Descriptions

From the literature, nine species have been attributed to the genus *Epiclintes* Stein, 1862. Clearly some of these species are not valid and some have been described on more than one



Figs. 8–9 (8) Electron micrograph of *Epiclintes felis* illustrating the multilamellate pellicle of the dorsal surface, fixed by method 1. The pellicle is 16 layers thick with a repeat distance of 6·2 nm, bar represents 40 nm; (9) Electron micrograph of *Epiclintes felis* illustrating a section through a dorsal sensory bristle, fixed by method 2, bar represents 0·1 μm.

occasion. Thus study reduces the number of nominal species to three, *E. felis, E. caudatus* Bullington, 1940 and *E. radiosa* Calkins, 1902. Corliss (1979) noted that one species of *Epiclintes* resembled the genus *Uncinata*. However no member of the genus *Epiclintes* recorded in the literature resembles this giant species with its characteristic beak-like uncinus.

Two species that have been assigned to the genus, but differ fundamentally from the others are *Epiclintes vermis* Gruber, 1884 and *Epiclintes pluvialis* Smith, 1900. *E. vermis* with its vermiform body closely resembles other hypotrich genera such as *Holosticha. E. pluvialis* superficially resembles *Epiclintes* but clearly is in possession of a symmetrical peristome. It lacks ventral cirri and the dorsal cirri were said to be long and 'hispid'. These two species differ sufficiently from the diagnosis of the genus *Epiclintes* to warrant exclusion.

Key to species of *Epiclintes*

1	Frontal 'styles' absent	2
–	Frontal 'styles' well developed, numbering four or five	***radiosa***
2	Ventral cirri in two longitudinal rows	***caudatus***
—	Ventral cirri in eleven diagonal rows	***felis***

Epiclintes felis (Muller, 1786) comb. n.

Trichoda felis Muller, 1786
Oxitricha felis Bory St Vincent, 1824
Oxytricha auricularis Claparède & Lachmann, 1858
Epiclintes auricularis Stein, 1862
Epiclintes ambiguua Wallengren, 1900
Epiclintes ambiguus Kahl, 1932

DIAGNOSIS A psammophilic species commonly found on or adjacent to the sand surface. The body is characterised by its extreme flexibility and contractility. When extended, three regions of the body are apparent. There is a typically auriform anterior, a cylindrical 'trunk' region and an elongate 'tail'. The peristome is asymmetric running around the apex of the cell and into a buccal cavity on the left. The paroral apparatus is small and is situated on the right of the buccal cavity. The cytopharynx is clearly visible. The width of the anterior is equal to, or one and a half times as broad as the trunk. This central region tapers posteriorly to the tail. It is translucent and full of food materials. The contractile vacuole is single and placed centrally or just behind the peristome. A cytoproct lies adjacent to the dorsal surface at the junction of trunk and tail. Macronuclei are small, oval and numerous. The tail is elongate, at least the length of the anterior and central portions combined. It is rounded at the tip and often displays a plaited appearance. The dorsal surface is equipped with three longitudinal rows of sensory bristles, running from the extreme anterior to the tip of the tail, one in the mid-line, the other two at the lateral edges. Ventrally the head is equipped with three rows of short cirri running diagonally from right to left. The trunk has eight rows similarly arranged, the last two of which enter and run down the tail. These two progress right to the tip. Two lateral rows of marginal cirri are present, beginning near the peristome and extending to the point of the tail. A longitudinal row of transverse cirri runs down the left side of the trunk, beginning at the first trunk row and terminating where the tail region begins. In addition, a short row of four or five caudal cirri are present at the extremity of the tail. A prepared slide of *Epiclintes felis* stained by the silver impregnation technique of Tuffrau (1967) has been deposited in the collection of the British Museum (Natural History), accession number 1982 : 2 : 12. Average length 100–300 μm but may shorten to at least 25% of this initial length. *Epiclintes felis* has been recorded from many locations. Claparède &

Lachmann (1858) found the organism on the coast of Norway and noted that it had also been collected in the Baltic Sea. Stein (1864) similarly found this species in the Baltic but more recent researches have shown it to be truly cosmopolitan. Hartwig (1977) gave an extensive list of its distribution and locations will only be listed briefly here; North Sea, Baltic Sea, White Sea, Gulf of Naples, French Adriatic and Mediterranean Coasts, Black Sea, Caspian Sea, Sea of Japan, Bay of Bengal, American Atlantic Coast, Coast of Mauretania, Brazilian Coast and the Coast of Great Britain.

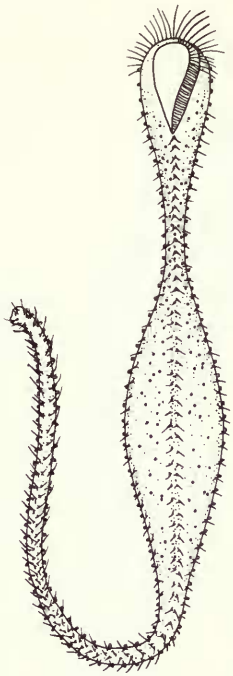


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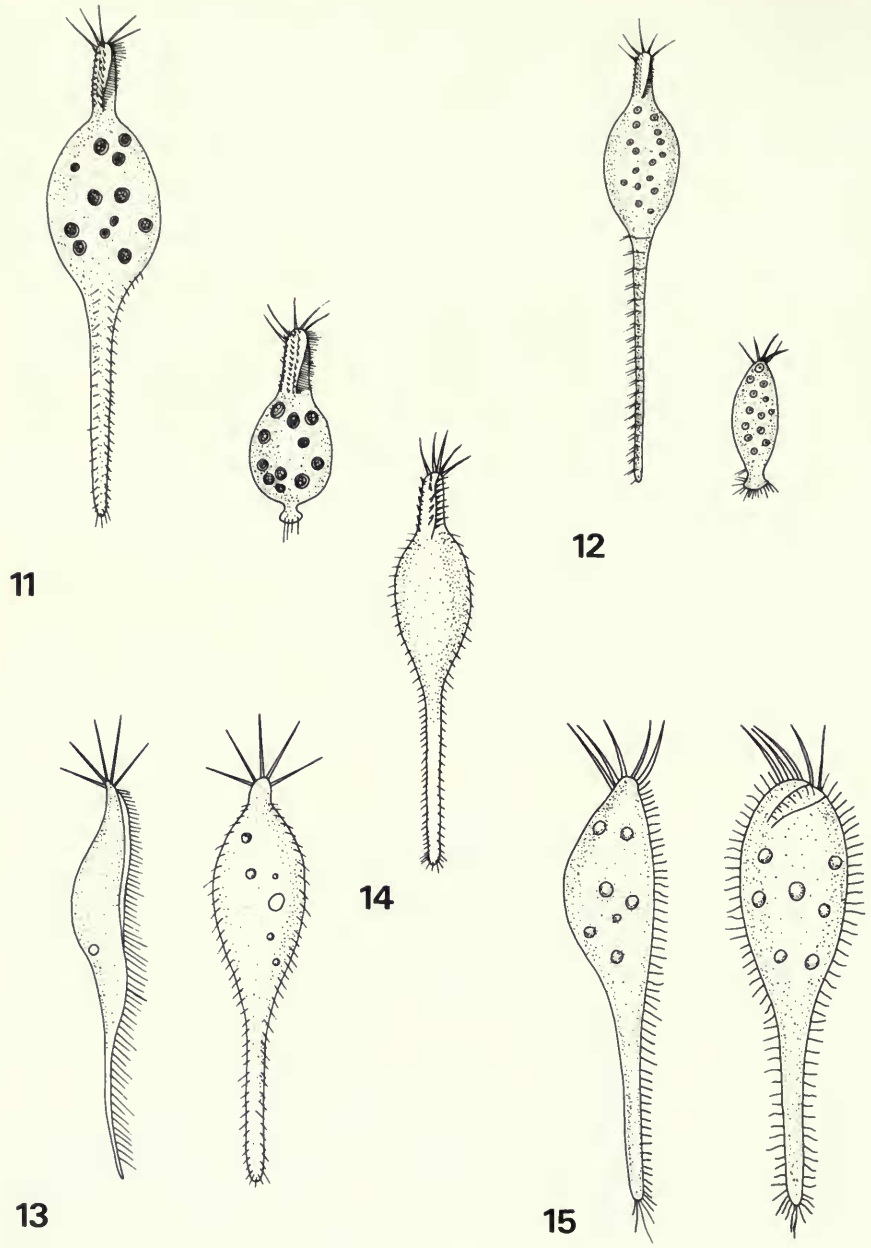
Fig. 10 *Epiclintes caudatus* After Bullington, 1940, ventral view.

Epiclintes caudatus Bullington, 1940

Diagnosis (Fig. 10) A very long and slender hypotrich, widest centrally and dorsoventrally flattened. It is extremely extensile and contractile. The body is divided into three regions, the anterior portion is almost but not quite equal to the central portion in width. The 'tail' is long and narrow, slightly enlarged at the tip. The peristome is asymmetric and traverses around the head region terminating in a buccal cavity on the left side. Sensory bristles emerge from the dorsal surface, at the lateral edges of the cell, beginning in the mid-peristome region and extending to the tip of the tail. Two longitudinal rows of ventral cirri are present, situated on either side of the midline. Two rows of marginal cirri are also present. In the original description the colour was said to be yellowish and the length at rest was 354 μm and the width 28·6 μm. The three regions of the body, an asymmetric AZM, the presence of dorsal sensory bristles, marginal cirri and a high degree of contractility contribute to the inclusion of this species in the genus *Epiclintes*. Only two rows of ventral cirri were noted, running longitudinally. This, together with a very elongate head region and a very long tail process serve to distinguish it from *E. felis*. A marine species isolated from the



Figs. 11–15 (11) *Oxytricha retractilis* After Clapareide & Lachmann, 1858, ventral view of relaxed and contracted organisms; (12) *Oxytricha longicaudata* After Strethill-Wright, 1862, ventral view of relaxed and contracted organisms; (13) *Mitra radiosa* After Quennerstedt, 1867, lateral and ventral views of relaxed organism; (14) *Mitra retractilis* After Kahl, 1932, ventral view of relaxed organism; (15) *Epiclintes radiosa* After Calkins, 1902, lateral and ventral views of relaxed organism.

West Indies. These organisms usually swim in left spirals but when locomoting over a substrate or the underside of the surface film they were seen to move without spiralling, in circles, to the left and right.

Epiclintes radiosa Calkins, 1902

Oxytricha retractilis Claparède & Lachmann, 1858
Oxytricha longicaudata Strethill-Wright, 1862
Mitra radiosa Quennerstedt, 1867
Epiclintes retractilis Kent, 1881–1882
Mitra rectractilis Kahl, 1932

DIAGNOSIS A marine species which like *E. felis* has been described by many authors in various states of contraction. *O. retractilis* Claparède & Lachmann (1858) and *O. longicaudata* Strethill-Wright (1862) were both described in the extended state. (Figs 11 & 12). They identified three distinct regions of the body, a narrow anterior with asymmetric peristome, a central region that was distinctly ovoid and an elongate highly contractile 'tail' which nearly disappeared on shortening. Strethill-Wright (1862) noted that this tail had a plaited appearance. Five long anterior cirri were observed by both authors. Quennerstedt (1867), Kahl (1932) and Calkins (1902) all described the organism in the contracted state whereupon the tail shortens considerably and the head and central portions tend to be seen as a single unit. Quennerstedt (1867) (Fig. 13) noted the organism was five times as long as broad and that five long straight frontal cirri, he termed 'styles', were present. This author also noted that a single row of marginals were present upon each side of the anterior and central portions, and a double row bordered the tail. Kahl (1932) noted that *M. retractilis* had a short row of five transverse cirri by which the organism attaches to the substrate. Again four or five long frontal bristles were noted (Fig. 14). Calkins (1902) described the peristome as wide on the right and narrowing as it approached the left side of the body, mention was also made of attachment to the substrate by posterior cirri (transverse cirri) of the tail (Fig. 15). Kahl (1932) was the first to group these independently described organisms under the name *Mitra retractilis*. However as Kent (1881–1882) had already pointed out, the name *Mitra* had previously been assigned to a genus of mollusc and was therefore preoccupied. Thus Kahl's designation is invalid. The additional description by Calkins (1902) erected the name *Epiclintes radiosa* for the organism described by Quennerstedt (1867). The sizes quoted for these organisms are 80 μm for *O. retractilis*, 75 μm for *M. retractilis* and 45 μm for *E. retractilis*. This marine species has been recorded from Norway, Scotland, Heligoland, Kiel Sea, Finland, White Sea and the Atlantic Coast of the USA. Vital information on numbers and arrangement of cirri are unfortunately lacking, but they have been grouped due to the characteristic frontal cirri and the conspicious highly contractile tail. Further information is required on this interesting species before a definite decision can be taken regarding its validity.

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